

1999. Accordingly, Applicants respectfully submit that this response is being timely filed.

Claims 73-134 were pending prior to the instant amendment. By this amendment, new claims 135-144 are added to recite additional features of the present invention to which Applicants are entitled. Consequently, claims 73-144 are currently pending in the instant application.

The newly added claims 135-144 recite each of the concentrations of carbon, nitrogen and oxygen is measured by SIMS, which is described on page 9, lines 10-23 in the specification.

Claims 73-134 are rejected under 35 U.S.C. 103(a) as being unpatentable over Zhang, U.S. Patent 5,614,733, 5,604,360 or 5,563,426, in view of Yamazaki, 5,543,636. This rejection is traversed for the reasons advanced in detail below.

The present invention relates to a thin film transistor including a crystalline semiconductor island, source and drain regions, a channel forming region, a gate insulating film, and a gate electrode where the channel forming region includes no grain boundaries. Specifically, the semiconductor island includes carbon, nitrogen at a concentration no higher than $5 \times 10^{18} \text{ cm}^{-3}$ and oxygen at a concentration of not higher than $5 \times 10^{19} \text{ cm}^{-3}$. More specifically, the semiconductor island is formed in a monodomain region which contains no grain boundary.

Applicants contend that the location of a crystalline semiconductor island of the claimed invention, in particular, a channel forming region, is specified and different from any other references. The crystalline semiconductor island is intentionally formed in a monodomain region by patterning a crystallized semiconductor film, so that the crystalline semiconductor island has no grain

boundary. As shown in Figs. 2B and 4B, the specific feature is first noted in the present application.

Zhang et al. '733 teaches that local concentrations of catalytic material "(e.g. those at grain boundaries)" (emphasis added) are preferably not in excess of $1 \times 10^{20} \text{ cm}^{-3}$ (See, column 3, lines 16-17). Further, Zhang et al. '733 discusses "barriers" at "grain boundaries," which could not be removed if only thermal annealing is conducted, can be "lowered" (emphasis added). In addition, "even amorphous components remaining at the grain boundaries can be crystallized." (See, column 4, lines 5-13). As a result, there is no indication that the semiconductor islands of Zhang et al. are formed in a monodomain region of the semiconductor. The disclosure of catalytic material concentrations at grain boundaries and barriers at grain boundaries does not support the Examiner's conclusions on page 2 of the Office Action. Otherwise, the concentrations and barriers would not have to be addressed since they would not affect the semiconductor islands, if they were formed in monodomain regions as suggested by the Examiner.

Further, Zhang et al. '360 includes disclosure relating to the "grain," namely, that the speed of the crystal growth after the production of nucleus also remarkably increases in the crystallization of the amorphous silicon thin film formed on a certain metal after forming it when the growth of the crystal "grain" after the production of nucleus is studied by varying heating time (See, column 3, lines 1-16).

It is apparent that neither '733 nor '360 is related to forming the semiconductor island in a region where no grain boundary is included. Accordingly, neither of the Zhang references teach the crystal boundaries are much larger than the length of the channel regions, as suggested by the Examiner.

With respect to Zhang '426, it is disclosed that it is not preferable to provide the semiconductor element on the end of the crystallization (it is also disclosed that a portion where the crystallization started from a plurality of starting points hit each other) because a large grain boundary (a portion where crystallinity is discontinued) exists and the concentration of metal elements which accelerate the crystallization, such as nickel, is high in those regions. Accordingly, a pattern of a coating film containing the metal elements which become the starting point of the crystallization and accelerate it such as nickel and a pattern of the semiconductor element must be optimized in forming the semiconductor element utilizing the present invention (See, column 6, lines 41-55).

In the '426 reference, it is noted that the semiconductor element is not preferably provided on the end of the crystallization and that the pattern of the metal film and the pattern of the semiconductor element should be optimized. However, an exact location of the semiconductor island or the channel forming region shown in Figs. 2B and 4B of the present specification is not determined or disclosed. It is noted in Zhang '426 because the end portion of the crystallization includes the metal element higher than other portions, an electrical property of the semiconductor element will be prevented by such the metal element. Therefore, there is also no teaching or suggestion in the '426 reference that the semiconductor island be formed in a monodomain region.


On the other hand, according to the claimed invention, at least the channel forming region is formed inside the monodomain, so that it can avoid the presence of any grain boundary in the channel forming region. As a result, the present invention is patentably distinguishable from the cited references.

Claims 123 and 129 are also rejected under 35 U.S.C. §112, second paragraph, as being indefinite with regard to the recitation of "S-value."

One of skill in the art would understand this term to mean the subthreshold factor sometimes referred to as an "S-factor". This value or factor is the reciprocal number of the slope of the subthreshold current against gate voltage. When the S-value is small, a leak current can be reduced when a gate current is zero. Applicants provide an excerpt from the *Dictionary of Semiconductor Terms*, including a translation of the relevant definition (Exhibit A) to show that the term is known to those having skill in the art. As a result, these claims should be considered definite, and the rejection overcome.

In view of the foregoing, it is respectfully requested that the rejections of record be reconsidered and withdrawn by the Examiner, that claims 73-134 be allowed, that new claims 135-144 be allowed and that the application be passed to issue. If a conference would expedite prosecution of the instant application, the Examiner is hereby invited to telephone the undersigned to arrange such a conference.

Respectfully submitted,


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